Dryden Flight Research Center
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DRYDEN HANDBOOK

CODE X

AIRWORTHINESS AND FLIGHT SAFETY REVIEW, INDEPENDENT REVIEW, MISSION SUCCESS REVIEW, TECHNICAL BRIEF AND MINI-TECH BRIEF GUIDELINES

Electronically Approved By:
Associate Director

DOCUMENT HISTORY PAGE

This page is for informational purposes and does not need to be retained with the document.

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August 27, 99	Revision B	3, 19	Modified 2nd paragraph on page 3 and last sentence on page 19
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See IDMS Document Master List	Revision D	All	Entire document modified.

PURPOSE AND SCOPE

The purpose of this document is to maximize the effectiveness of the airworthiness and mission success processes as they are practiced at the Dryden Flight Research Center.

This document presents the following: requirements/responsibilities of the Airworthiness and Flight Safety Review Board (AFSRB), the AFSRB Chairperson, and the DFRC Independent Review (DIR) Committee when one is formed; a sample DIR outline as a guide for the DIR Chairperson's consideration during the review process; Items which should be covered in the DIR Committee's report to the AFSRB; Mission Success Review requirements and guidelines; and Technical Brief and Mini-Tech Brief guidelines.

AIRWORTHINESS AND FLIGHT SAFETY REVIEW BOARD

The Airworthiness and Flight Safety Review Board (AFSRB) is tasked with performing certain review processes in order to ensure the flight safety of all projects that are conducted at Dryden Flight Research Center. The Dryden Organizational Manual (DOM) provides the authority for carrying out this task.

In order to implement the assigned task, the AFSRB is given the responsibility and the authority to perform reviews that will vary depending upon the complexity and the criticality of the project under consideration.

The DFRC Center Director appoints the Chair and the members of the AFSRB. The Board members are the line organizational Directors, ex Officio members, the Chief Pilot, and the Chief of the Safety Office. Other U.S. Government personnel may be appointed to the AFSRB as necessary to provide a thorough review.

Airworthiness and Flight Safety Board Review

The first level, but least extensive, of the AFSRB review is that conducted solely by the Chairperson of the AFSRB. He has the responsibility of determining whether a specific project need be reviewed at any further depth or by any larger Committee than he alone. If, in his judgment, the project plans and preparations are adequate to perform their proposed operation with the necessary level of safety, he has the authority to cease the reviews at that point and authorize the conduct of the project's plans. This is documented by an approval memo with concurrence by the Center Director.

The second level of review is one step beyond the sole review of the AFSRB Chairperson. If the Chairperson decides that a specific project needs further review, but does not require the full airworthiness board review, he may convene a small team of Dryden experts, independent of the project, to assist him in determining whether the proposed project is cleared for flight. If the

Chair and the small team agree that the project should be cleared for flight, this will be documented by an approval memo with concurrence by the Center Director.

The third level of review is to have the plans and proposed conduct of the project presented to the entire AFSRB for its review. In this case, the entire Board will pass judgment on whether a particular project has adequately considered and integrated flight safety into its proposed plans. This will be based upon a presentation to the AFSRB by the project. The recommendation of the Board to the Center Director will be based on the general agreement of the members, with each major objection addressed and resolved. A quorum consists of the Chairperson, representatives of Codes F, O, P, R, and if structures/loads issues are present, a representative of Code RS. Airborne Science projects require the presence of a Code Y representative.

The fourth level of review is to have the plans and proposed conduct of the project presented to the AFSRB by a team of experts, independent of the project, to determine whether the proposed project is cleared for flight. This team is called a DFRC Independent Review (DIR). The entire Board will pass judgment on whether a particular project has adequately considered and integrated flight safety into its proposed plans. The recommendation of the Board to the Center Director will be based on the general agreement of the members, with each major objection addressed and resolved. A quorum consists of the Chairperson, representatives of Codes F, O, P, R, and if structures/loads issues are present, a representative of Code RS. Airborne Science projects require the presence of a Code Y representative.

In any of the four review types mentioned, the AFSRB Chairperson has the authority to obtain assistance from any part of Dryden or any outside help that may be necessary to ensure that the project will be conducted in as safe a manner as possible. This assistance can take many forms, such as the hiring of a consultant, using the aircraft manufacturer's expertise, using experts in various fields, or forming ad hoc committees to assess any or all parts of the proposed program.

DFRC Independent Review (DIR)

The Chairperson of the AFSRB may establish a formal DIR to assist him and his panel in judging whether a specific project is adequately prepared to proceed with its proposed program. Typically, a DIR should be formed if any of the following criteria is present:

1. Any new program or operation that can reasonably be assumed to contain significant risk to personnel or property.

2. A phased program that is ready to enter a second or succeeding phase, beyond that already approved by the AFSRB.

3. A program that is preparing to exceed some limit previously approved by the AFSRB.

4. A program that will require a major modification to the aircraft.

The DIR must be established at a time when credible review and assessment can be made without delaying the operational schedule of the project, but in all cases, before the first flight or major operation of the project. DIRs are normally limited in scope to address safety as the main subject of review but may also include a Mission Readiness Review charter.

A DIR Committee is charged to:

1. Conduct an independent review and assessment of the entire program or operation and assure that adequate and proper planning and preparation have been accomplished, resulting in the project being conducted in an acceptable, safe manner. This review should include, where applicable, the design, fabrication, performance, and documentation of all software and hardware associated with the project as well as ground and flight operational procedures. It should also include any substantiating wind tunnel, computational fluid dynamics, ground, and/or simulation testing that has been performed.

2. Verify that the approved System Safety Plan has been followed and that all the analyses and results have been properly integrated into the project's planning and tracking documentation.

3. Ensure that all identifiable risks have been identified, assessed and either adequately controlled or presented to the Center Management as risks that must be accepted in order to conduct the program.

4. Provide engineering and technical recommendations to program personnel throughout the life of the DIR, while recognizing that it is not a function of the DIR to direct actual work effort.

5. Maintain on-going communication between the DIR members, program personnel, DFRC management, and the Chairperson of the AFSRB.

6. Submit a final report of Committee activity, findings, and recommendations to the Chairperson of the AFSRB.

The membership of the DIR Committee is selected to represent specific functions and disciplines necessary for an objective review and assessment of the particular project and its proposed plans. Broad experience and expertise are desirable among the Committee members in order to assure recognition of potential problems in a wide range of areas. The members will not be associated with the program being reviewed in any manner such that their activities or recommendations may be influenced through such causes as an over-familiarity with the project. The chairperson of the DIR committee, a DFRC Civil Servant, is a senior engineer with extensive experience and expertise in the major discipline of the project. Other members may be drawn from NASA field Centers and from the private sector as long as they are independent from the project under review.

The members of this Committee may go to their respective supervisors and/or the Safety and Mission Assurance Office for help or advice in interpretation of the Committee's charter. But, it is extremely important that the individual member remain totally independent from line management biases while operating as a Committee member. The line management has the responsibility to ensure that individuals working under them have the time and priority necessary to do a thorough job as a Committee member.

The Committee should take advantage of other advisors and consultants to assist them in fully reviewing the project. If an outside consultant must be hired, the project should provide funding. Decisions and recommendations are the sole responsibility of the Committee and its Chairperson.

One purpose of the DIR review is to expose individual or Committee concerns to higher management and the project while there is still time to avert a mishap. Therefore, project team members are encouraged to reveal information freely, cooperate with the review team(s), and be totally open in all conversation including any doubts or uneasiness felt by the project team. Inviting the DIR Committee members to attend pertinent project meetings wherever applicable can emphasize this. The Project Team and the DIR Committee have a common goal and often the DIR Committee can help the project in attaining this goal. Briefings by the project team should be presented by qualified personnel to familiarize the Committee with overall efforts and specifics of all areas under evaluation. It is the responsibility of the project personnel to assure that all information presented is current, complete, and accurate; all hardware, software, and equipment submitted for evaluation is properly prepared and represents actual configuration and functional characteristics intended for use; and all known or suspected anomalies, deficiencies, or areas of concern are identified.

Constant communication between the DIR Committee and the project team can provide benefits in both directions. A concern or recommendation voiced to the project team in a timely manner may allow the project to take action without delaying the project. Likewise, the proposed action of the project team, communicated to the DIR Committee in a timely manner, may uncover areas of confusion or misunderstanding on the part of either the Committee or the project that could lead to an unnecessary expenditure of valuable time and/or resources.

Upon completion of the Committee's review, the Chairperson of the DIR will prepare a report for the Chairperson of the AFSRB. This report should be presented in writing to the AFSRB chairperson. This report should include the Committee's recommendations, any unsatisfactory or marginal areas or conditions, any restrictions or limitations that should be imposed before the proposed operation may take place, and a discussion of any hazards that must be presented to the Center Director for acceptance. The report should ordinarily be signed by all the DIR Committee members, but the Chairperson may sign in an individual's absence if he states that the absent member either concurred in the majority report or has filed a minority report. Any member not concurring with the majority report should submit a minority report stating any areas of nonconcurrence or additional claims or recommendations as appropriate. Typically, the DIR will present an oral briefing to the AFSRB. The written report should be delivered to the AFSRB and the Project Manager at least 48 hours prior to the meeting of the AFSRB.

The DIR oral briefing to the AFSRB should include the material presented in the written report. Typically, the DIR chairperson and DIR committee members will present the briefing. Project team members should be present to answer very specific questions that may arise. Hardcopies of the oral presentation should be prepared and presented to the Project Manager and AFSRB members 24 hours prior to the AFSRB meeting.

Along with the presentation of the DIR Committee's final report, the Project Manager of the affected project will submit a report to the Chairperson of the AFSRB, addressing any open action items or recommendations that may have been in the DIR report that need action before the first flight or significant operation of the project. Following these two report submissions, the AFSRB will make its final recommendations as to whether the project should be allowed to continue on the course it has planned or should make some modification to their plans before continuing.

In order to allow sufficient time to allow the AFSRB to arrive at a decision without undue pressure, the DIR final briefing to the AFSRB must precede the Project's Technical Briefing by a minimum of three workdays. It is also important to note that the Technical Briefing should precede the first flight/operation by a minimum of two working days. The DIR Committee should be present at the Technical Briefing in order to concur on closures of any issues that were deferred to the Tech Brief. For smaller projects with less broad scope, the above times may be compressed.

DIR Outline

The outline in Appendix 1 is offered for the DIR Chairperson's consideration when conducting a DIR of an assigned project. The Committee's primary concern is to investigate all matters that affect public, flight, range, and ground safety. Any items noted that may affect mission success may be reported, but are not the primary concern of the Committee.

Mission Success Review

A Mission Success Review (MSR) may be conducted at any time in the life of the project to ensure the highest probability of success. The content, defined by the AFSRB Chair, is tailored, so it will vary from project to project. The review normally will be conducted and presented by the project team but the AFSRB Chair may establish a special team to do the review. The MSR may be done separately or in combination with a safety review. The MSR report will be presented to the AFSRB as a written report followed by an oral presentation no sooner than two days after receipt of the written report.

The MSR team may be commissioned to review:

1. Project or program requirements to see that they are clear and that mission success will satisfy the requirements.

2. The flow-down process, to assure that derived requirements for subsystems are traceable to the project requirements.

3. Project risk assessment to see that all reasonable risks to mission success have been identified, assessed, and dispositioned or presented to Center Management as risks that must be accepted in order to conduct the program.

4. The design, fabrication, performance, and documentation of all software and hardware associated with mission success.

5. Substantiating wind tunnel, computational fluid dynamics, ground testing, flight testing, and simulation testing that have been performed, including off-nominal conditions.

6. The data acquisition and manipulation plan.

7. The flight planning and envelope expansion process.

8. Test range and control room operations, communications paths.

9. Cost estimating methods

10. Project schedules and milestones for reasonableness and conformance, project reviews and problem reporting and resolution methods

Technical Briefs and Mini-Tech Briefs

The Technical Briefing, or Tech Brief, is one of the more important tools used by Dryden to insure the safe and efficient conduct of the flight test mission. Its major function is to continue the review process after the AFSRB Review Committee has made its final recommendations and a program moves into the flight phase.

There are two primary purposes for holding Tech Briefs. First, the individual Project Office is given the opportunity to present its goals and plans to a group of peers. These peers represent all the various disciplines at Dryden, with special emphasis from the particular areas of interest that are being explored during the proposed flight tests. A Project, in this way, receives the benefit of the experience and expertise of the projects that have been conducted before. The peer review, using past experiences, is a proven way of bringing overlooked items to light.

The second purpose of Tech Briefs is to present a current assessment of Project risks to the Dryden management team. It allows management to reconsider its understanding of the risks involved, prior to each flight. This helps to insure that any risks that cannot be eliminated or reduced will be accepted at the appropriate level of authority and responsibility.

Holding a Tech Brief prior to each flight of a research aircraft allows an adequate amount of time to process and thoroughly review the data received from the previous flight. This forces a more comfortable, and safe, pace without the project feeling they are being rushed into proceeding with the flight program after only a cursory look at the data.

The Project Manager is responsible for both scheduling and presenting the Tech Brief. The presentation should include, where applicable, the following:

A. A review of past flight(s) -

This review should address the data analysis results from previous flights of the aircraft with particular emphasis on envelope expansions or any unexpected results, whether they are expected to present a problem or not. These results should provide a smooth transition to the objectives of the proposed flight plan. Pilot comments from past flights should be addressed, particularly where the flying qualities of the aircraft are unexpected or not as good as have been expected. Significant anomalies or failures from previous flights must be reviewed.

B. Objectives of the proposed flight -

The objectives of the particular flight should be presented in light of the results of previous flights and as a piece of the overall objectives of the entire program. Rationale and justification for the proposed flight should be shown based on an orderly progression from the data points already obtained.

C. Flight Plan -

The planned approach to obtaining the data maneuvers should be explained with emphasis on the technique and rationale for using it. Any risks, limits or constraints on the aircraft or maneuvering should be presented and clearly explained with no assumptions made as to understanding of these critical areas. Preplanned alternatives should be presented to allow for unforeseen contingencies that may occur during flight. This plan should cover the entire flight period from take-off to landing and give a clear and concise understanding of the pilot's duties at all times. If there is to be a period of pilot familiarization during flight, that should be briefed at the Tech Brief. This is not meant to limit the pilot's freedom, but to constrain all research aircraft flying to that which has been preplanned and briefed.

D. Configuration Changes -

A brief review should be made of the configuration that the aircraft will be in for flight. This is particularly important where there has been a change made to the aircraft between flights, no matter how small or seemingly unimportant. Additional risks perceived to have been incurred as a result of the changes must be briefed in the Tech Brief.

E. Control Room Operations-

For those Projects requiring a control room, the presentation of the Control Room procedures should include the lay-out of the room, the people that are involved in the flight, what data they will be looking at, and for, and instrumentation requirements. Any changes to the room or its functions should be explained and the communication network, both with the aircraft and in the Control Room, should be briefed. Any control room training accomplished or needed prior to flight should be included.

F. Accepted Risk List -

Every Tech Brief must present a list of any risks that are being taken knowingly by the Project. These risks may have arisen through various analyses such as a Hazard Analysis or may have shown up on previous flights or tests as discrepancies and processed through the normal Discrepancy Reporting system. In either case, the associated risk and the authority for accepting it must be clearly explained and justified.

G. Mandatory Requirements -

Every flight of a research aircraft will have a specific set of personnel, instrumentation, and equipment required in order to conduct the flight as planned. This list must be presented at the Tech Brief along with the action to be taken in the event that a person or item is not present, or operating. This could be cancellation, flight abort, or the deletion of a specific maneuver or series of tests, but the idea is to have it all thought out in advance with precise alternatives planned and prepared for. This list should include all personnel required in the Control Room operation.

H. Open Items -

Occasionally, there are items that represent a major problem area and the Project is delayed until the items can be closed out satisfactorily. More often, the items are less severe and just lack the necessary information at the time of the Tech Brief. These may normally be carried forward and closed out at the Crew Brief before the Project is cleared to proceed with its proposed flight.

Technical Briefings must be scheduled a minimum of two working days in advance of the proposed flight date. If not, it is the responsibility of the Project Manager to personally contact each of the mandatory attendees and notify them of the upcoming briefing. The actual scheduling is done through the Aircraft Operations Scheduling Office but remains the responsibility of the Project Manager. He must also be sure the Aircraft Operations Scheduling Office is informed of any changes so the bulletin board in the Flight Operations Directorate Office can be kept up-to-date. The keeper of the Dryden Center Calendar should be notified as soon as a date and time has been established so that no conflicting meetings will be scheduled. Dryden management has given the Tech Brief the highest priority.

The presence of the following individuals or designated representative is considered mandatory before a Tech Brief may be conducted. In the event any individual, or a designated representative, is not present the Project Manager will cancel the Tech Brief and reschedule it at a later date.

Project Manager
Project Pilot
DFRC Chief Engineer (Tech Brief Committee Chair)
Director, Research Engineering
Director, Aerospace Projects or Airborne Sciences as appropriate
Director, Flight Operations
Director for Safety and Mission Assurance
Director, Research Facilities

Desired attendees:
Principal Investigator
Designated technical monitor(s) (for each project) from Research Engineering

It is desirable for DIR Committee members to attend the first Tech Brief after their report to the AFSRB to ensure that actions directed by the AFSRB have been complied with by the Project. It is the responsibility of the person chairing the DIR to notify the members regarding the Tech Brief.

Directorate management must assure that designated representatives report issues and results back to the directorate management to insure continuity of directorate technical and safety monitoring.

It is up to each individual on the Mandatory Attendance list to maintain a current list of designated representatives that may attend Tech Briefs in his/her absence. A copy of the proposed flight request/mission plan will be made available in each of the Directorate Offices at least one day prior to the scheduled Tech Brief. It has been customary to circulate a draft of the proposed plan to all the interested parties a few days in advance of the Tech Brief. This is a desirable policy and should be exercised whenever possible. It gives the attendees the benefit of being fully prepared when they come to a Tech Brief as well as giving the Project Team the benefit of some potential feedback at a much earlier point in the planning process. It will also allow each of the mandatory attendees enough time to insure that they or their representatives can be at the actual briefing. Following the Tech Brief, the Directorate Directors (Operations, Projects or Airborne Science, Research Engineering, and Research Facilities) will approve and sign the Flight Request Form. The Chief Engineer will sign the Flight Request Form to indicate approval to conduct the operation.

Any of these rules may be altered to fit a special case through negotiation with the Chief Engineer's Office. One example of a rule change that is allowed is the "Block Tech Brief," where a series of flights is briefed all at one time. This would also include aerial refueling of a research aircraft where "one" flight is, in effect, two or three normal ones.

Although block briefing is often allowed, there is good reason and benefit from having the Project take the necessary time between flights to analyze the data before proceeding on with the flight program. This is especially true where an envelope is being expanded and data maneuvers proposed for a flight are highly dependent upon results from a previous flight. The usual technique is to expand the envelope on the first flight of a series and then use the remaining flights to fill in data points, or to expand an envelope in a different disciplinary area. Then a Tech Brief is conducted before a further expansion takes place.

A "Mini-Tech" covers only a limited new agenda aimed toward a few items that need clarification before continuing with a series of flights. It is not a substitute for a Technical Briefing. Approved agenda items are: prior flight results, relatively minor changes in configuration, prior flight anomaly explanation and analysis, minor changes to the Tech Briefed flight plan, and close-out items from Project reviews. Items covered at the Tech Brief must be readdressed, but may be covered by a statement such as " F. Accepted Risk List: No changes from the Tech Brief".

The "two day before flight" requirement is relaxed with Mini-Techs to facilitate the safe but rapid conduct of the mission. A Mini-Tech may be held immediately prior to the Crew Brief for most block-briefed flights, after the first flight.

The signatures of the appropriate entities on the previously briefed Tech Brief Flight Request must be reaffirmed by signature and dated. The signatures show approval of the flight as briefed at the Tech and Mini-Tech briefings.

The final decision on what will or will not be allowed for any given project still ends up being a decision by the DFRC Chief Engineer based on what makes the most sense for conducting the safest and most efficient flight test program possible.

APPENDIX 1

REVIEW BOARD CHECKLIST

The purpose of a review is to provide NASA management assurance that a satisfactory approach has been taken to achieve safe and productive flight operations. Reviews communicate an approach, demonstrate an ability to meet requirements, and establish current status.

The objectives of a review are: to establish that all interfaces are compatible and function as expected, confirm that the system and support elements are properly configured and ready for launch, and to receive assurance that flight operations can proceed with acceptable risk.

This checklist provides a non-exhaustive list of items to address for review team guidance when conducting an independent review. The team may select only those items that apply to the project reviewed. The list draws heavily from the Mars Climate Orbiter investigation.

1. PERSONNEL

(a) Leadership

• Emphasis on safety as the primary concern
• Experience level of personnel
• Clear line of authority to person in charge
• Examine team working and external interfaces.
• Teamwork promotion.
• Training opportunities provided
• Mentoring of new or inexperienced personnel

(b) Organization and Staffing

• Sound organizational structure
• Staffing adequacy
• Customer representation
• S&MA representation

(c) Communication

• Ranking of safety and mission success over cost and schedule
• Free exchange of information, opportunity to be heard
• Tracking of top ranked issues and their resolution to everyone's satisfaction
• Problem reporting encouraged

• Line organization and project communications

(d) Project Team

• Key positions filled and continuity encouraged
• Experience level of team members
• Adequacy of project team's reviews: PDR, CDR, Wind tunnel, test readiness, simulation
• Customer involvement in decision making and trade-offs
• Team acceptance of external ideas
• Team metrics relation to requirements

2. <u>PROCESS AND EXECUTION</u>

(a) Systems Engineering

• Risk trade-off system used by the project
• Risk management system used
• Ground test versus flight test trade-off
• Fault tree analysis used
• Margin adequacy for parameters
• Mission architecture provides data for failure analysis
• Emphasis on mission success over cost and schedule
• Formal review of past lessons learned
• Rigorous configuration control process in place.

(b) Requirements

• Mission success criteria established and baselined.
• Requirements level sufficiently detailed.
• Change process used and effective
• Derived requirements flow from base requirements

(c) Validation and Verification

• Verification matrix structure and completeness
    Vertical: Mission phase or hardware part or software
    Horizontal: Function, qualification method (analysis, test, similarity, none), results
• Sound verification processes
• Evidence that processes are used
• Mission critical software identified and treated as such
• System interface validation and data handoff
• Simulation as a verification and validation tool
• Other validation and verification facilities
• IV&V for software

• Normal and off-nominal (contingency and emergency) testing
• Test repeats after configuration changes
• End-to-end testing results and configuration freeze

(d) Cost and Schedule

• Funding adequate to accommodate program
• Bottom up budget and schedule
• Cost and schedule reserves
• Mission success compromise for cost

(e) Government and Contractor Roles and Responsibilities

• Roles and responsibilities defined (written), workable, and followed
• Experience level of contractor work force

(f) Risk Management, Analysis, Test

• Risk relationship to cost, schedule, and content of project.
• Risk analysis tools used: FMEA, FTA, PRA, etc.
• Problem reporting procedures
• Single-point failures identified and remedied or accepted
• Hardware and software reuse certification
• Day of flight configuration testing
• Potential failures identified, modeled, and overcome or accepted
• Thoroughness of failure postulation

(g) Independent Reviews

• Review conducted by technical peers or experts
• Sustained support for review members
• Review independence from common management
• Review results reported to top management

(h) Operations

• Contingency planning validated and tested (simulated)
• Contingency training of personnel
• Mission Rules formulation and reasonableness
• Telemetry and health monitoring during critical operations

(i) Center Infrastructure

• Senior management mechanisms for visibility into the project
• Line organization accountability

(j) Documentation

• Documentation of design decisions and limitations
• Decisions communication to all concerned
• Documentation process must be continuous
• Electronic documentation distribution availability

(k) Continuity and Handover

• Transition plan for handover
• Personnel transfer with handover
• Recipient team training by development team
• Training of recipients in procedures and databases.
• Continuity in key positions; overlap
• New processes generated by the transition
• Transition risks

(l) Mission Assurance

• Adequate mission assurance staffing
• Mission success processes in place and followed

3. <u>TECHNOLOGY</u>

• Technology adequately matured
• Technology solutions alternatives considered
• Risk level of new technology
• New technology use and limitations

4. <u>TECHNICAL AREAS</u>

View technical areas with the purpose, goals and objectives of the Project in mind.

• Aerodynamics
    Control surface effectiveness
    External pylons, stores, protuberances, fixtures, mounts
• Alternate landing sites
• Aircrew
    Aircrew Evaluation of Simulation Results, aircraft readiness, problem areas
    Guest aircrew inbriefing
    Review of Flight Crew Training, Procedures, and Qualifications

• Avionics
  Redundancy, reliability
  EMI testing
• Carrier Aircraft (Mothership)
  Crew qualifications
  Communications paths
  Interfaces, launch panel
  Pylon, hooks, sway braces
  Separation Analysis
  Sling loads

• Computational Fluid Dynamics analysis

• Configuration Control
  Project Requirements
  Flight vehicle under configuration control
  Hardware
  Software

• Control Room Operations
  Communications Links
  Display and Layout: Monitoring and Analysis
  GRIM
  Key Personnel and replacements
  Security
  Uplink capability

• Data acquisition and transmission

• Documentation

• Experiment(s) Description

• Flight Envelope and Expansion Plans
• Flight Controls
  Flight controls computers and software functions
  V&V, IV&V
  Certification Standard (Level A: Flight Critical)

• Fuels and oxidizers: hypergolics, pyrophorics, oxygen
• Ground Operations and servicing
• Ground Support
  Airfield Facilities

Communications Equipment
Ground Support Equipment
Maintenance Facilities
Navigation, Guidance, and Landing aids

• Ground Testing
Communications
Drag chute and deploy mechanism
Free taxi operation (disconnected from tow)
Ground track
Outside air temperature limit
Steering method
Support vehicles
Tow operations and tow connector link
Wind and Crosswind limits

• Guidance, Navigation, and Control onboard
• Handling Qualities
Predictions: Simulation, analog

• Hazard Analysis
Hazard identified
Severity and Probability levels
Risk Matrix
Accepted risks
• Human Factors
• Hydraulics
Redundancy
• Inspection methods at contractor's location and at DFRC
• Instrumentation
Air data system, FADS, pilot, computer influence
Go/No go
Mishap reconstruction capable
Research data acquisition

• Life Support
Anti-G suit
Egress capability
Parachute characteristics, fit compatibility
Pressure suit
Sharp edge survey

• Mission Rules
Limitations

Operational restrictions

• Operations
  Checklists
  Emergency Procedures
  Fact Sheet
  Manuals

• Parachutes, Vehicle
  Construction
  Pyrotechnics, Mortar

• Pilot training (ground and flight)

• Project Overview
  Experiments Planned
  Facilities required
  Hardware, Software
  Objectives
  Procedures used

• Propulsion
  Launch vehicle
  Research vehicle

• Range Requirements

• Range Safety
  Abort landing sites
  Beacons
  Command Destruct System
  Encryption
  Expected casualty calculations
  Flight Termination System
  Operating area
  Trajectory

• Recommendations by the Review Board
  Action Items

• Research Vehicle
  Vehicle purge
  Landing gear

Mass properties
Pilot intervention for UAVs
Thermal protection

• Risk Management
  Assessment of residual risk
  Accepted Risk List
  Hazard Identification
  Severity and probability matrix

• Simulation
  Certification: qualified for use
  Configuration Management
  HIL, AIL
  Nominal, off-nominal testing
  Verification
  Validation

• Software
  Configuration Control
  IV&V
  Simulation

• Stage Separation
  Aerodynamics
  EMI
  Ordnance

• Structures
  Aeroelastic effects
  GVT
  SMI
  Sideslip-dynamic pressure combination (ßqbar)

• Uncertainty Analysis
  Margins
  Monte Carlo Analysis

• Validation and Verification
  Validation: System performs adequately to accomplish the mission: Test, Analysis, Demonstration, Similarity, Inspection, Simulation
  Verification: System performs according to the specification: Test, Analysis, Demonstration, Similarity, Inspection, Simulation
  All up end-to-end check: Thermal, vibration, shock, pressures, etc. all combined

- Vehicle Health Monitoring
- Waivers
- Wind tunnel predictions
- Wiring
- Work Breakdown Structure

SAMPLE QUESTIONS FOR REVIEW BOARD MEMBERS

MODIFICATIONS

1. Can the type and amount of power available support the electrical requirements of the installations?

2. Have operating procedures and an inspection checklist been developed for the installation?

3. Is cooling air adequate to properly cool avionics? In flight? On ground?

4. Have partial flight manuals and checklist been prepared and approved?

5. Have weight and balance figures been computed and are they within recommended limits?

6. Does the installation of test equipment in the aircraft interior keep aisles and emergency exits clear for evacuation?

7. Do installed racks and test equipment have projections (bolts, rivets, knobs, handles) which could cause injury to aircrew personnel?

8. Does instrumentation installed in the cockpit obstruct vision or egress or add discomfort and distraction to the aircrew?

9. Is the aircraft properly placarded and has the test instrumentation in the cockpit been properly identified and marked?

10. Do any external modifications affect the pitot-static system?

11. Have magnetic interference (RMI) ramifications been considered? Will flight day RMI be different than other days?

12. Have modifications been photographically documented on film or video?

13. Review fact sheet. Are all changes incorporated?

INSTRUMENTATION

1. Has the proposed and/or completed installation been inspected by the project test aircrew to ensure that it offers the safest possible installation? Has a cockpit safety design board approved the changes and documented approval?

2. Has a complete set of operating instructions been formulated and published?

3. Are the instrumentation appendages (nose boom pitot head, vanes, etc.) ahead of the engine checked regularly for structural integrity?

4. Has proper consideration been given to the separation of shielding of instrumentation and aircraft wiring, especially in the area of weapons system control circuits?

5. Have provisions been made for coordinating the data when more than one recording device is to be used?

6. Have adequate written procedures been developed for the maintenance, inspection, and calibration of the instrumentation?

7. Has a complete set of emergency or alternate procedures for test instrumentation failures been formulated in order that some part of a scheduled mission can be accomplished safely with certain instrumentation inoperative?

8. Are you reasonable certain that this test can be conducted safely?

9. Is it necessary or advisable to monitor internal black-box temperatures monitored? Inflight? On ground? During build-up and maintenance?

10. Are black boxes instrumented to reveal elapsed operating hours? On-off cycles? Are hours and cycles frequently monitored and documented?

11. Are film/tape time limits on recorders and cameras understood? Speeds? Initiation and shutoff times?

12. Has the instrumentation installation been documented by photography/video prior to flight?

MAINTENANCE

1. Are there any special maintenance procedures that will be required to support the test? Are they published as a requirement?

2. Have inspection requirements been compiled into preflight, postflight, and phase documents.

3. Has the aircraft and in particular, the modification areas been thoroughly inspected for foreign objects?

4. In the case of joint maintenance support, who is in charge?

5. Are you reasonably certain that the test can be conducted safely?

FLIGHT CONTROL ROOM -FLIGHT OPS

1. For each flight test maneuver or event:

    - Who are the key people monitoring the event? Are they properly trained?

    - What recorders, channels, and parameters are being monitored for critical and precautionary indications?

    - What are the critical and precautionary limits for the given event?

    - Is there any question concerning whom you notify, how you notify them, and with what urgency? Are there any questions concerning how you expect people to react when you notify them of a critical or precautionary indication?

2. Is there any question concerning the parameters monitored, type of sensor used, or the method of display?

3. Are you satisfied with the limits and accuracy of the monitored parameters? With interfaces with other monitored parameters?

4. Have you checked scaling and sensing (direction) of the parameters you are to monitor?

5. Are you satisfied with your communication network, procedures and equipment?

6. Are flight envelope limits clearly defined and understood before flight by necessary persons?

7. Will you be able to detect faulty instrumentation indications of critical flight parameters?

AERODYNAMICS

1. Have all aspects of new design or modification been considered for effect on aerodynamics? Weight? CG? Inertia? Exterior Configuration? Surface control movements? Pitot-static system? Other instrumentation? Etc.?

2. Have effects of in-flight unplanned alteration of appendages or flight surfaces been assessed?

3. Is the aero model satisfactory? Any undue concerns? How are you going to verify the aero model during envelope expansion flights? During

4. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

5. Is instrumentation satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?

6. Do you have any undue concerns about questions in the “Flight Control Room Flight Ops” section of this document?

7. Have all safety and mission concerns been adequately addressed?

8. Are you reasonably certain flight can be conducted safely?

AEROSTRUCTURES

1. Have all aspects of new design or modification been considered for effect on structure and vice-versa?

2. Are ground load and ground vibration tests adequate? Any evidence of airframe vibration (flutter, buffet, acoustics)?

3. Is instrumentation satisfactory? Does it tell you all you need to know for safety and mission accomplishment? What are the shortcomings?

4. Do you have any undue concerns about questions in the “Flight Control Room Ops” section of this document?

5. Have all safety and mission concerns been adequately addressed? What factor of safety in design or test? What Margin of Safety?

6. Are you reasonably certain flight can be conducted safely?

CONTROLS (FLIGHT, ENGINE, ETC.)

1. Have all "fail to operate" and full hardover impacts been assessed?

2. Is the system implemented as intended by the designer? How is assured?

3. Have end-to-end tests been conducted on the full-up total system? Have all credible inputs been accomplished to observe system response?

4. Do all lights and indicators obtain intelligence from credible sources?

5. How does failure or erroneous signal in a light or indicator impact safety or mission accomplishment?

6. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

7. Is there a “last resort” provision to switch back to a previously annunciated failed system in the event vehicle loss is imminent anyhow? (i.e. - the system may be healthy with the warning system malfunctioning.)

8. Have all prudent efforts been considered to continue operating system in a degraded “get-home” condition in lieu of switching to a dormant or benign backup system whose health is not utterly known?

9. Has consideration been given to using parallel-active dual systems rather than primary-active, backup-benign systems?

10. In the event of a failure, will an impacted item be automatically positioned at an optimum setting (i.e. - engine speed, flight control surface, etc.)?

11. Do you have any undue concerns about questions in the “Flight Control Ops” section of this document?

12. Have all safety and mission concerns been adequately addressed? Has a system safety assessment been accomplished?

13. Are you reasonable certain flight can be conducted safely?

MAN/MACHINE DYNAMICS

1. Have all aspects of new design or modification been considered for effect on dynamics and vice-versa? Weight? CG? Inertia? Exterior configuration? Surface control movements? Pitot-static system? Other instrumentation? Etc.?

2. Have effects of unplanned alteration of appendages or flight surfaces been assessed?

3. Is simulation satisfactory? Have appropriate sensitivity changes been examined?

4. Is instrumentation satisfactory? Does it tell you all you need know for safety and mission accomplishment? What are the shortcomings?

5. Do you have any undue concerns about questions in the "Flight Control Ops" section of this document?

6. Have all safety and mission concerns been adequately addressed?

7. Are you reasonably certain flight can be conducted safely?

PROPULSION

1. Are propulsion characteristics compatible with the intended flight envelope? Altitude? Speed? G-force? Angle of attack? Sideslip?

2. Where is flameout or engine stall anticipated?

3. Are procedures adequate to avoid overtemp or other engine damage?

4. Are engine recovery procedures adequate?

5. Is testing in an area where emergency power-off landing can be safely conducted?

6. Are flight control and electrical/hydraulic power adequate for power-off landing.

PROJECT MANAGEMENT

1. Have all the policies of Dryden Management System Manual (DMSM) been addressed?

2. Has a review of all system safety documentation been accomplished?

3. What are your mission rules and accepted risks?

4. What configuration control process is utilized?

5. Has the Project utilized appropriate Lesson Learned databases?